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CAUSES OF FATAL ACCIDENTS ON HIGHWAYS

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CAUSES OF FATAL ACCIDENTS ON HIGHWAYS

By WILLIAM SMITH, A.M.[1]

The appalling loss of human life at grade crossings has at last caused attention to be directed to this serious and perplexing problem. It has been the purpose of this investigation to endeavor to ferret out the underlying causes of fatal accidents on the public highways and particularly at grade crossings for a definite district and for a given period of time.[2] The district that was chosen was Los Angeles County and the period of time which was included extended from January 1, 1912, to December 31, 1915, or a term of four years.

Every possible source of information was consulted. The records in the County Coroner's office furnished the largest percentage of reliable data. Reports of the California Railroad Commission and of the Motor Vehicle Department of the State of California contributed further material. Data were secured, also, from the railroad companies and from private sources.

The study has been confined to fatal accidents. The same causes operate in the case of the injuries as in that of the fatalities,—so there would be very little gain in studying the cases of injury. In the report of the State Engineer, statistics for three years show that the injuries upon highways were about four times as numerous as the deaths.

In trying to learn the causes, the investigator has found himself dealing with phenomena which are very complex. So many

[1] [EDITOR'S NOTE.] Graduate Student in Sociology, 1915-1916, University of Southern California.

[2] Statistics compiled by the Interstate Commerce Commission (Report of the State Engineer to the California State Railway Commission, Dec. 1, 1915, p. 1) show that for the year ending June 30, 1914, a total of 1296 persons were killed and 3602 were injured in the United States at grade crossings. In 1914, with less than 4 per cent of the population of the United States and with less than 2 per cent of the steam railway mileage, California furnished nearly 5 per cent of the deaths and injuries.

TABLE I.

CAUSES OF FATAL ACCIDENTS ON HIGHWAYS, LOS ANGELES COUNTY, JAN. 1, 1912 TO DEC. 31, 1915.

		Age of Deceased Persons								
	Causes	1-10	11-20	21-30	21-30	41-50	57-60	61-70	71-	Total
1	Lack of Proper Caution by Drivers of Motor-Vehicles,—Carelessness,	20	16	46	34	28	35	15	16	210
2	Dangerous Crossing—Obstructed View, Insufficient Protection, etc.....	5	7	15	18	11	10	6	7	79
3	Lack of Proper Caution by Pedestrians and Bicyclists.....	1	2	11	13	16	13	9	6	71
4	Boarding and Leaving Cars in Motion	0	2	6	9	7	10	6	4	44
5	Thoughtlessness of Youth, Paving on Streets, etc.....	18	13	0	0	0	0	0	0	31
6	Mechanical Defects in Machinery, Brakes, Roads, etc.....	0	2	5	4	4	7	2	0	24
7	Lack of Proper Caution by Railway Men.....	2	0	3	6	1	2	4	3	21
8	Physical Defects in Hearing, Sight, Old Age, Infirmities, etc.....	0	0	1	0	1	1	11	6	20
9	Confused by Traffic.....	1	1	1	1	3	1	3	3	14
10	Lack of Proper Caution by Drivers of Vehicles.....	0	0	4	0	3	1	0	0	8
	Total.....	47	43	92	85	74	80	56	45	522

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elements and complications enter into nearly every case that very rarely is one found which does not have several contributing causes.[1]

There are no two cases alike; different situations and elements enter into each. Because of this, it would not be difficult to fit the cases into some scheme to suit the particular investigator. However, in this study the investigator has not had any brief to prove and has not entered upon the task with foregone conclusions, but has endeavored to take the attitude of an impartial judge.[2]

Tabulations of Accidents and Their Causes.—To bring the problem before us, let us consider some of the facts. Table I includes all (except a few noted elsewhere) of the fatal accidents on the highways of the County for four years from January 1, 1912, to December 31, 1915. In this tabulation it has been the endeavor to place the accident under the cause which was most fundamental; but in nearly all cases there were other contributory causes. Under the first heading, "Lack of proper caution by drivers of motor-vehicles," have been placed all of those accidents in which this element played the most important part. Since there were other contributory causes, the drivers of automobiles will bring the charge of unfairness, but the contributions which the automobiles made in the other cases, will counterbalance this seeming injustice. A number of fatalities are charged against "Dangerous Crossings" where the automobiles are not taken into consideration, even though they were contributory in many instances. Thus, when we take all of the elements into consideration, a fair balance has been struck between the different causes.

The total number of fatal accidents tabulated is 522. In addition to this number there were a few cases where the Coroner's

[1] From the transcripts in the Coroner's office, one case may be cited, which shows the complexity of the problem. Passengers were getting off of a Watts car on the Pacific Electric line, and the crossing bell was ringing. The man on the motorcycle heard the bell, but supposedly thought that the presence of the Watts car was the cause of the ringing of the gong. A Redondo car came from the same direction as the Watts car and struck the motorcycle. The rider could not see the Redondo car because of the Watts car which was standing still. What was the main cause of the accident?

[2] If the investigator had an automobile bias he could readily interpret the cases to show the carelessness of the pedestrians; if he leaned toward the railways, he could readily prove that people crossing the tracks were grossly negligent; and the pedestrian could find ample data to show that the railways and motorists have little regard for his safety.

TABLE II.
CAUSES OF FATAL ACCIDENTS AT GRADE CROSSINGS
LOS ANGELES COUNTY, 1912-1915 INCLUSIVE.

		Age of Deceased Persons								
	Causes	1-10	11-20	21-30	31-40	41-50	51-60	61-70	71-	Total
1	Dangerous Crossing,—Obstructed View, Bad Approach, Insufficient Protection	5	6	15	18	10	11	7	7	79
2	Lack of Proper Caution by Drivers of Motor-Vehicles	0	2	5	6	5	4	0	4	26
3	Lack of Proper Caution by Pedestrians and Bicyclists	0	1	5	8	6	3	0	3	26
4	Lack of Proper Caution by Railway Men	0	0	3	6	1	1	4	0	15
5	Infirmity of Age, Defective Sight, Hearing, etc	0	0	0	0	0	1	1	6	8
6	Thoughtlessness of Youth	4	2	0	0	0	0	0	0	6
7	Lack of Proper Caution by Drivers of Equestrian Vehicles	1	0	1	0	1	2	0	0	5
8	Mechanical Faults,—Inefficient Breaking Apparatus, etc	0	0	0	0	1	2	0	0	3
	Total	10	11	29	38	24	24	12	20	168

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inquest was waived and the records contain nothing but an entry such as, "Death caused by automobile accident."[2]

This table gives for the year 1912, 87 deaths; for 1913, 139; for 1914, 142; and for 1915, 154. The largest percentage of accidents is due to lack of proper caution on the part of motor-vehicles, for which the figures are 31, 47, 54, 78; the next largest percentage is due to the dangerous railway crossings for which the figures are 15, 13, 26 and 25. The writer has not been able to find out the causes for the "lack of proper caution" on the part of individuals. Intoxication figured in many cases, but it has not been possible to determine the number.

Table II gives the accidents at the grade crossings of the County. In this table the street railways, as well as the steam and interurban electric lines, have been taken into consideration, but no accident has been taken into account here unless it happened at a crossing.

The total number of fatalities at the grade crossings for the four-year period is 168. The numbers by years are as follows: 1912, 31; 1913, 38; 1914, 51; 1915, 48. The dangerous conditions that exist at the crossings are responsible for the largest number of accidents, while lack of caution by pedestrians and motor-vehicles comes next in order. This table shows a rise in the number of fatalities during the first years, but in 1915 there was no increase over the figure for 1914.

TABLE III.
VEHICLES AND PEDESTRIANS THAT FIGURED IN ACCIDENTS, 1912-1915, LOS ANGELES COUNTY.

Year	Steam Train	Electric Car	Automobile	Motor-Cycle	Bicycle	Horse Vehicle	Pedestrian
1912	6	40	31	9	....	5	40
1913	4	53	81	16	10	8	65
1914	18	52	80	22	9	6	54
1915	10	33	106	15	6	10	61
Totals	38	178	298	62	25	29	220

Table III shows that steam trains figured in 38 accidents, electric cars in 178, automobiles in 298, motorcycles in 62, bicycles in 25, horse-drawn vehicles in 29, and pedestrians in 220. Among the

[2] In 1915 there were 18 such cases. These were omitted because there was no way of securing adequate information.

vehicles, there has been the largest increase from year to year, in the number of accidents caused by automobiles, and if the automobiles and motorcycles be taken together as motor-vehicles, then the totals for each year will be 40, 97, 102, and 121.

From these figures it is very evident that the motor-vehicle is very closely related to the accident problem. In this connection, a consideration of the growth in the number of automobiles will be of value.

The Motor Vehicle Department of the State of California has furnished the following statistics concerning the registration of automobiles in the State:[1]

1905	4,729
1912	29,169
1913	31,790
1914	122,877
1915	164,060

These figures show a gain of 9% from 1912 to 1913, of 286% from 1913 to 1914, of 34% from 1914 to 1915. The registrations for 1915 show an increase of 462% over those of 1912, and the number registered in 1915 increased over the number for 1905 by 3369%.

At this juncture let us consider the population statistics for Los Angeles County. According to the estimates made by the Chamber of Commerce of Los Angeles, the population of the County increased approximately 35% in the period 1912-1915. Comparing the percentage of increase made by the population with that made by the automobiles, we find that the latter has increased out of all proportion to the increase in population.

Increases in Los Angeles County.[2]

	Population	Automobiles
1912-1915	35 %	About 400%
1914-1915	4½%	27%

[1] In addition to the above figures, there were motorcycle registrations for 1914 and 1915 of 24,800 and 26,220 respectively. Motorcycles were not registered prior to 1914.

[2] The automobile registrations were not segregated prior to 1914, so this percentage is only an estimate. The per cent of increase for the State for that period is 462, so 400% would be a conservative figure for Los Angeles County.

Since an automobile is comparatively easy of control, many drivers are tempted to become careless and are apt to forget the momentum of a heavy car even though it is travelling at a moderate rate of speed. It would be safe to say that very few drivers are aware of the fact that the danger, in all cases, increases as the square of the speed.[1]

To illustrate, let three machines of the same kind be taken at speeds of ten, twenty, and forty miles per hour. The machine at twenty miles, while the speed has only been doubled, has stored up in itself four times the energy of the car moving at ten miles, and it will strike an object with four times the force of the first one; the third car moving at the rate of forty miles (four times the speed of the first one) will strike an object with sixteen times the force of the first one. In turning a corner, the machine at forty miles is sixteen times as likely to upset, skid or strip a tire as the one at ten miles; and when the power has been shut off and the brakes applied the machine will go sixteen times as far before stopping. Ignorance of or disregard for this principle has led to many accidents.[2]

Table IV gives the fatalities according to sex and age for the period 1912-1915 in Los Angeles County. The number of males is 398 and the females 124, making a total of 522. The males, as we might naturally expect, outnumber the females, because they are brought into closer contact with traffic. In the period 1 to 15 years there is a total of 69 cases, while at the other end of the scale, from 66 to 85, there is a total of 73. These two groups with a total of 142, belong to the weak and unprotected classes which, in our present stage of civilization, we pretend to protect; but still they fall in large numbers. From 16 to 60, the period that should be given up to the working life, there is a total of 352 (274 males and 78 females). The period from 26 to 45, which is usually devoted to home-making, has a total of 160 fatalities. Among the

[1] By a law of physics K.E. $= \frac{1}{2} M V^2$. The kinetic energy, or the energy a body has in consequence of its motion, is directly proportional to the square of the velocity.

[2] Figures furnished by the Motor Patrol Department of Los Angeles County throw some light on the matter of speeding. The Department was organized March 28, 1912, and since then the following arrests have been made for "speeding": 1912, 3,271; 1913, 4,316; 1914, 3,440; 1915, 4,241. This shows a considerable number of arrests, but does not tell the whole story because the small force of patrolmen were not able to detect all offenders.

TABLE IV.
FATAL ACCIDENTS ON HIGHWAYS, LOS ANGELES COUNTY,
ACCORDING TO SEX, AGE, CALENDAR YEAR, 1912-1915 INCLUSIVE

Age	1-10		11-20		21-30		31-40		41-50		51-60		61-70		71-00		Total		Total
Sex	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	†
Year 1912	4	0	3	1	11	2	14	3	17	7	5	7	4	3	6	0	64	23	87
1913	12	5	13	3	23	8	12	4	13	1	18	2	14	0	8	3	113	26	139
1914	10	3	12	0	21	6	20	1	9	7	20	6	11	5	10	1	113	29	142
1915	7	6	7	4	21	0	19	12	16	4	17	5	10	9	11	6	108	46	154
Total.....	33	14	35	8	76	16	65	20	55	19	60	20	39	17	35	10	398	124	522

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126 males many heads of families were taken away, leaving homes without bread-winners, and the 34 fatalities among the females, left several homes without the wife and mother. From 46 to 65, the time when men are mature and should be most valuable to society, there were 148 fatalities. These 522 deaths mean a stupendous loss socially; and society cannot afford to carry this process on indefinitely.

Analysis of Causal Factors.—In this accident problem, four factors must be taken into consideration; they might be termed mechanical, physical, psychical and economic.

The Mechanical Factors.—Of all these, the mechanical factor is most easily handled, because it is the most tangible; it has to do with such things as the machinery and the forces of nature that are employed for moving traffic. If the speed problem were in the mechanical category, it could be solved very easily and effectively by constructing all motor-vehicles so they could not possibly go beyond a certain speed. There are certain elements of the accident problem which can be made to yield very readily to technical science. The matter of grade separations belongs in the mechanical category and all of the accidents attributable to the grade-crossings are preventable. The only obstacle in the way of making these separations, is that of the tremendous costs involved. There are, however, other mechanical elements that can be remedied at small cost. In Table I, one of the causes given is, "Boarding and leaving moving cars," and that item has to its credit a total of 44 fatalities in the period 1912-1915.

The arrangement of most electric cars in Los Angeles tempts many persons to try to board them while in motion. Young and athletic men might be able to do so successfully for some time, and it seems so easy that older men make the attempt; but sometimes with fatal results. The same holds true with regard to leaving the cars. However, not all of these accidents are due to such voluntary attempts at boarding or leaving the moving cars; several persons have fallen off because the cars were crowded; several, while standing near the exit, ready to leave, have been thrown by a sudden lurch of the car; several sick and intoxicated persons have fallen off, and several accidents resulted from a lack of proper caution on the part of conductors, who gave the starting bell while passengers

were still on the car steps. American haste also has much to do with the matter.

It would be an easy matter to say that these accidents were due to carelessness and consequently "unavoidable"; but, nevertheless, it is a mechanical problem and entirely preventable at comparatively small cost. The street cars of St. Paul and Minneapolis, Minnesota, are equipped with gates that are operated by the motorman. These gates are closed before the cars begin to move and are never opened until the cars come to a full stop. Such an arrangement avoids all such accidents, for not even an intoxicated person can be thrown off, even if he should fall down the steps. The Los Angeles cars, which have the entrance in the middle, have the advantage over the others, but the doors, which are very rarely closed, tempt many persons to board the moving cars.

In Table I, there is an item, "Mechanical defects in machinery, brakes, roads, etc.," which has charged against it a total of 24 cases. This leads to the question as to whether or not the braking apparatus on the cars is as efficient as it should be. Very often it seems that accidents could have been prevented had the operation of the brakes been independent of weather conditions. The ordinary wheel brake is very uncertain on wet rails. The electro-magnetic brake, that is largely used in Europe, has proved itself to be very efficient. When this is applied it lifts the car and thereby decreases the efficiency of the wheel brakes, but in the case of the electro-magnetic brake,[1] the magnets pull the car against the rails, which amounts to the same as an increase in weight, thereby making the wheel brakes even more effective, and in addition to which there is the action of the electro-magnetic brake shoes upon the rails.

The Physical Factor.—The second factor that enters into the problem is the physical one. This has to do with such things as defective sight and hearing or any other physical defect in human beings. This cause is less tangible and more difficult to treat than the mechanical factor. This element enters very definitely into many cases, while in many it is impossible to tell what part it played. In the case of trainmen, this element is largely eliminated by examinations and it might be, at least, largely reduced in con-

[1] Scientific American 83:356.

nection with motor-vehicles by means of some rather rigid examinations, such as given in Europe before a license is granted to a driver. Without any question, such a procedure would materialy reduce the number of accidents. It might be feasible to require the driver of a motor-vehicle to have good sight and hearing before granting him a license to operate a machine upon the streets and highways, but serious obstacles would be encountered if an attempt were made to place restrictions upon a physically defective person in regard to his use of the public highways. Peculiar dangers threaten persons with sense defects, but such persons form an element in our population and must not be ruthlessly run over because of their misfortunes.

The Psychical Factor.—The third factor is the psychical one, and is by all odds, the most serious problem of all.[1] By virtue of great individual differences in human minds, the problem becomes greatly complicated.

Any person who ventures upon a public thoroughfare must be able to perceive the conditions of traffic, to analyze them and then to decide on appropriate action to secure safety. If any one of these mental operations fails to function properly, then disaster comes. In many individuals, the sensory organs do not transmit their impressions to the brain with sufficient despatch. This dullness may be due to defective mentality or to several other causes. In many cases the mind is so completely wrapped up in some thought, that it becomes a blank to anything external. In such a case the real situation is not perceived and, even when the danger is sensed, the mind cannot drop instantaneously what has been occupying it and direct with precision the necessary action. This state of affairs is rather common among deep thinkers and those who are overcome with emotion of any kind, be it joy or grief. In certain cases some particular element in the traffic grips the attention to the exclusion of everything else. Under such circumstances, the mind cannot possibly have accurate data by means of which to direct any necessary movement, and a slight inaccuracy may prove fatal. In many persons the attention flits from one thing to another with the result that it is impossible to discriminate between the insignificant and the important elements in the traffic. A person in haste usually is

[1] Scientific American Supplement 68:127.

bent upon carrying out some object quickly and consequently he pays little heed to the things about him. Any of these conditions places a person in great peril on the highways today.

There are marked differences in the acuteness of the sense organs: for instance, one person hears better than he sees, and vice-versa. On a busy thoroughfare a person must be able to take in the entire situation, he must consider the width of the road, the speeds at which the various vehicles are moving, and the changes that will be likely to occur before he can lay out a safe path for himself. In a tangled web of traffic, there are great diversities, and here the differences in perception come into play. One person may be able to analyze a certain part of the situation, but be unable to evaluate other elements and consequently act wrongly at the critical moment.

It might be possible to lay down a code of regulations that would, if mastered, relieve the situation materially, but it would be a long process to make such really effective; and, when learned, new conditions would arise, calling for a new set of rules to be learned through the slow process of costly experience. The automobiles have come so suddenly that no such snail-like method could possibly cope with the situation.

It is a very easy matter to say that the persons who are killed were careless, but that does not alter the facts. When a man is run down by a train where the crossing bell was ringing, it is said at once that he "ignored the crossing bell and signals." But is that a fair judgment? Perhaps there were two trains, one coming from each direction, and he was so absorbed by one train that he was utterly oblivious to the other one. A man walked across a track without looking up and was struck by an electric car. Was it carelessness? It is entirely possible that he was so deeply absorbed in thought about the dangers of grade-crossings that he did not realize his danger in the slightest degree. It may be that he was merely absent-minded, but that is the failing of some of our greatest intellects. Some persons become so accustomed to hearing bells and whistles that they do not notice them, and others become so accustomed to them that at certain times they think that they hear the warnings whether they are sounded or not.

So long as the present conditions exist and so long as men are psychic beings, some absent-minded or thoughtful persons will be

compelled to give up their lives. It is very evident that the automatic flagmen and some of the other devices at the crossings are inadequate, because they do not prevent accidents. Without any doubt there is a large amount of carelessness, but there are many fatalities that can not be charged to this fact. The railways are conducted for the people; they are public utilities and must take into consideration the people with their diversities, frailties and their psychic peculiarities. When we deal with human beings we cannot fix up cast-iron systems in the abstract and then try to force men into these rigid forms. Various devices are placed at the crossings to protect folks and since they do not accomplish their purpose successfully, they are inadequate.

This psychical factor is by all odds the most difficult to handle and because of that very fact, we must lay greater stress upon the improvement of the mechanical factors.

The Economic Factor.—The fourth element to be considered is the economic factor. The report, which the committee representing the railways of California presented at the hearing held by the State Railway Commission in Los Angeles on March 7, 1916, says on page 10, "It is certain that a wholesale separation of grades is entirely out of the question." The report made to the Railway Commission by the State Engineer, in considering the matter of grade separations, says (page 15), "This is plainly out of the question with the funds which will be at the disposal of those who will be required to find the money for the proposed improvements." When calculations are made in regard to the crossing eliminations, we find that we are confronted by vast sums that stagger us. But there is another phase of the problem that needs to be considered also.

According to the computations of Engel, each person who reaches the age of twenty, costs society about $1000. According to Table IV, 90 persons, below 21, were killed. The deaths are distributed rather evenly by years from 1 to 21, so that it would be fair to take an average of one-half of the $1000. If $500 be taken as the cost to society of each one of these 90 persons, there would be a total of $45,000. Calculations have been made that the average economic value of the lives now sacrificed by preventable

deaths is $1700.[1] At this figure the 522 deaths in Los Angeles County in the four-year period considered, would amount to $887,400, a sum sufficiently large to eliminate several grade-crossings. Somebody must pay for this, and somebody does. Because many homes are bereft of the bread-winner, many women must toil to provide for young children; many children have to shoulder burdens too heavy for them to bear. This great loss means no inconsiderable drain upon charity, both public and private.

In medical lines we are turning more and more to preventive medicine, and find that this brings good returns. In the southern states, large sums of money are expended in stamping out the hookworm disease, and this enormous expenditure is considered a good investment. Medical inspection in the public schools is returning large dividends. If the public could be brought to realize the gain that would come through elimination of grade crossings, there would be immediate and generous appropriations made from public moneys (a part of the expense should be met by the railway companies) to eliminate the dangers to life and limb, that are now so common upon the highways. This matter of fatalities on the public highways, and especially at the grade-crossings, is a problem that deserves the further attention and consideration of all who have any regard for their own safety or for the safety of others.

[1] Fisher, Irving, Report on National Vitality, p. 118.